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Strontium isotope behaviour in early magmatic products during subduction initiation of the Izu-Bonin-Mariana arc

LEWIS W ROBINSON[1], KEVIN W BURTON[2], GEOFFREY M NOWELL[1] AND JULIE PRYTULAK[1]

[1]Durham University

[2]University of Durham

Presenting Author: lewis.w.robinson@durham.ac.uk

Subduction initiation is an integral but poorly understood part of Earth's tectonic regime. In particular, quantifying the magnitude and mechanism of elemental transfer from slab to mantle to arc lava remains an outstanding area of geochemical research. This work focusses on the magmatic record of subduction initiation recovered from International Ocean Discovery Program (IODP) Expedition 352, which drilled outboard the Bonin ridge. Expedition 352 recovered two main rock types: fore-arc basalts (FAB) and boninites. These rock types are closely spatially and temporally associated, and their eruption records the impact of changing slab inputs during subduction initiation [1]. Critically, older FAB lack an obvious subduction signature whilst younger boninites possess clear slab inputs [2]. We focus on the fluid mobile element strontium, presenting the high-precision $^{87}Sr/^{86}Sr$ and $\delta^{88/86}Sr$ isotope signatures of well-characterised FAB and boninite glasses to gain insight into slab-fluid transfer during subduction initiation. By comparing these two rock types, we can isolate the Sr isotope signature imparted by slab fluids, melts, and sediments.

We find that FAB, which are free from obvious subduction inputs, possess $^{87}Sr/^{86}Sr$ unradiogenic ratios with $\delta^{88/86}Sr$ that overlap with the observed range of MORB values. Boninites, which derive from a mantle source depleted by FAB extraction, possess more radiogenic $^{87}Sr/^{86}Sr$ than FAB, consistent with a contribution from pelagic sediments [2].Boninites possess heavier $\delta^{88/86}Sr$ than FAB and are typically similar to modern Mariana lavas $\delta^{88/86}Sr$ [3], despite lacking isotopically heavy plagioclase. Overall, combined $^{87}Sr/^{86}Sr$ and $\delta^{88/86}Sr$ isotope systematics indicate FAB derive from the melting of a depleted mantle source affected by plagioclase crystallisation. Boninites radiogenic $^{87}Sr/^{86}Sr$ and heavier $\delta^{88/86}Sr$ points to the addition of slab-derived fluids to the depleted FAB source, which appear more strongly affiliated with unaltered oceanic crust, rather than subducted sediments.

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